DOCUMENT RESUME

ED 403 230 SP 037 088

TITLE	Questioning and Understanding To Improve Learning and Thinking (QUILT): The Evaluation Results. A Proposal to the National Diffusion Network (NDN), Documenting the Effectiveness of the QUILT Professional Development Program.
INSTITUTION	Appalachia Educational Lab., Charleston, W. Va.
SPONS AGENCY	Office of Educational Research and Improvement (ED), Washington, DC.
PUB DATE	Feb 94
CONTRACT	RP91002002
NOTE	29p.
AVAILABLE FROM	Appalachia Educational Laboratory, Inc., P.O. Box 1348, Charleston, WV 25325-1348; (800) 624-9120.
PUB TYPE	Reports - Evaluative/Feasibility (142)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	Classroom Techniques; Cognitive Style; Elementary School Teachers; Elementary Secondary Education; Faculty Development; Inservice Teacher Education; *Learning Processes; *Questioning Techniques; Secondary School Teachers; *Student Behavior; *Teacher Behavior; Teacher Improvement; Teaching Methods; *Thinking Skills
IDENTIFIERS	*QUILT (Staff Development Program)

ABSTRACT

The goals of the QUILT program are to increase and sustain teacher use of classroom questioning techniques and procedures that produce higher levels of student learning and thinking, and to increase the incidence of student responses at higher levels of cognition. Educational research has established relationships between discrete questioning behaviors and student learning and thinking outcomes. Research also documents that most teachers have not incorporated effective questioning behaviors into their classroom repertoire. QUILT is intended to help teachers align their classroom questioning practices with "best practices" by supporting their change efforts over time. Local teams participate in a training-for-trainers that provides the knowledge, skills, and materials required to implement QUILT. Activities for faculty include: workshops; collegiums; observation sessions; and specified classroom applications. After one year's participation in QUILT, teachers in 13 schools showed significant gains in knowledge, understanding, and application of concepts related to effective questioning. A random sample of these teachers showed positive changes in their questioning techniques. Also, student answers to teacher questions were more often at cognitive levels above simple recall following teachers' participation in QUILT. Attachments include: the QUILT model; an annotated bibliography; a list of participants in QUILT field tests; and summaries of workshop evaluations and observation data. (ND)

ED 403 230

Questioning and Understanding to Improve Learning and Thinking (QUILT): The Evaluation Results

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A proposal to the National Diffusion Network (NDN), documenting the effectiveness of the QUILT Professional Development Program

Submitted by
Appalachia Educational Laboratory
P. O. Box 1348
Charleston, WV 25325

February 1994

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This publication is based on work sponsored wholly or in part by the Office of Educational Research and Improvement, U. S. Department of Education, under contract number RP91002002. Its contents do not necessarily reflect the views of OERI, the Department, or any other agency of the U. S. Government.

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Questioning and Understanding to Improve Learning and Thinking (QUILT)

Abstract

Goals: The primary goal of the program is to increase and sustain teacher use of classroom questioning techniques and procedures that produce higher levels of student learning and thinking. A related goal is to increase the incidence of student responses at higher levels of cognition.

Purposes and Needs Addressed: Educational research has established relationships between discrete questioning behaviors and student learning and thinking outcomes. Research also documents that most teachers have not incorporated effective questioning behaviors into their classroom repertoire and are not likely to do so without a structured, sustained, long-term effort to change routinized questioning behaviors. QUILT is intended to help teachers align their classroom questioning practices with "best practice" by supporting their change efforts over time.

Method of Operation: Local facilitation teams participate in a training-for-trainers that provides the knowledge, skills, and materials required to implement QUILT. Ideally, the entire faculty of an adopting school actively participates in the QUILT program that consists of: a three-day Induction training that presents the knowledge bases; seven 90-minute collegiums scheduled across the school year; seven opportunities to work with a partner to observe and be observed; and specified classroom applications.

Audience: All teachers, K-12, are the intended audience for the program.

Claims: After one year's participation in QUILT, teachers in 13 schools showed significant gains in knowledge, understanding, and application of selected concepts related to effective questioning. A random sample of these teachers showed significant, positive changes in the following behaviors: decrease in number of teacher questions, use of wait times I and II, redirection of questions, percent of questions at higher cognitive levels, designation of respondents before questions, and decrease in repetition of student answers. Student answers to teacher questions were at cognitive levels above simple recall significantly more often following teachers' participation in QUILT.

Basic Information

A. **Project Title**: Questioning and Understanding to Improve Learning and Thinking (QUILT)

Location: Appalachia Educational Laboratory (AEL)
Contact Person: Sandra Orletsky, Project Director, P. O. Box 1348, Charleston, WV 25325; 304/347-0400

B. **Original Developer**

The QUILT program was developed at AEL as part of the work of the School Governance and Administration (SGA) program, directed by Sandra R. Orletsky. The major authors and codevelopers are Jackie A. Walsh, educational consultant, and Beth D. Sattes, R & D specialist at AEL. The evaluator for the QUILT program is J. Jackson Barnette, professor at the University of Alabama.

The Appalachia Educational Laboratory (AEL), Inc., is a nonprofit corporation that works with educators in ongoing R & D-based efforts to improve education and educational opportunity. AEL serves as the Regional Educational Laboratory for the states of Kentucky, Tennessee, Virginia, and West Virginia. AEL works to improve professional quality, curriculum and instruction, community support, and opportunity for access to quality education by all children.

C. **Years of Project**

Developed: May 1989 - June 1991
Operated: June 1991 - present
Evaluated: June 1991 - June 1992 constituted the major field test
Disseminated: June 1992 - present

D. **Source of Development and Dissemination Funding**

FY 89 - FY 90	$140,000	from the U. S. Department of Education, contract 400-86-0001
FY 91	230,000	from the U. S. Department of Education, RP91002002
FY 92	181,000	from the U. S. Department of Education, RP91002002
FY 93	176,000	from the U. S. Department of Education, RP91002002

Listed above are the funds (from the Regional Educational Laboratory contracts) expended on the development, evaluation, and dissemination of the QUILT program. Local schools, local school districts, and states within the AEL Region have also contributed to development and evaluation costs; however, it is impossible to attribute precise dollar figures to these contributions. It is important to note that without the active participation and financial backing of these local schools, the development and evaluation could not have been done to such high and rigorous standards.

Description of Program

A. **Goals**

The primary goal of the Questioning and Understanding to Improve Learning and Thinking (QUILT) program is to increase and sustain teacher use of classroom questioning techniques and procedures that produce higher levels of student learning and thinking.

B. **Purposes and Needs Addressed**

Classroom questioning is perhaps the most used—and the most misused—of all instructional processes. On the average, teachers dedicate approximately 40 percent of classroom instructional time to the asking and answering of questions (Doyle, 1986); in machine-gun fashion, they pose an average of 40-50 questions in a typical 50-minute class segment. However, most of these questions are not well prepared and do not serve the purpose of prompting students to think (Dillon, 1988). QUILT attempts to help teachers improve the quality of the questions they pose and, in the process, reduce the number of questions asked. This results in a more reflective classroom environment—where teachers and students alike have time to think about the content and issues under study.

A tremendous gap exists between "what is" and "what should be" with regard to teacher questioning behaviors. In spite of the plethora of articles, books, and workshops on the topic of classroom questioning, teacher behavior remains relatively unchanged over 100 years of classroom observations and research (McNamara, 1981). From the inception of their work, QUILT developers sensed that the real need was to design a program that would support teachers in personal behavior changes—one that would help them change or alter firmly entrenched patterns.

C. **Intended Audience**

QUILT is a program designed for all teachers, K-12, in all content areas.

D. **Background, Foundation, and Theoretical Framework**

Development. In 1987, the Appalachia Educational Laboratory (AEL) contracted with Dr. Jackie A. Walsh to develop a 12-hour workshop on effective classroom questioning. The "Effective Questioning Workshop: Good Questions Don't Just Happen" was frequently requested in AEL's four-state Region; evaluations at the end of each training were positive and affirming of both (a) the importance of the content and (b) the appropriateness of the activities incorporated into the design of the workshop. Although the workshop was popular with educators in the Region, AEL staff questioned the wisdom of spending limited resources to conduct workshops. It seemed to be well accepted in the literature that workshops resulted (at best) in increased awareness but rarely in meaningful or measurable changes in teacher performance.

During this same time, the Kentucky Association of School Administrators (KASA) requested help for school administrators responsible for planning and delivering "effective" staff development. One of their criteria for "effective" was that it incorporate research about the change process and be a long-term program (as opposed to the predominantly one-shot programs that proliferate in schools).

The two agencies agreed to work collaboratively on effective staff development, and thus was born the KASA-AEL Study Group on Effective Questioning. Membership was comprised of 20 teachers and administrators from five Kentucky local school districts, KASA staff, and AEL staff. The study group worked for a full year (June 1989-1990) in the

development and pilot testing of concepts and materials that would become the QUILT program, which was not only firmly grounded in research and theory but also was well connected to the reality of living, breathing teachers and administrators in public schools. During the 1990-91 school year, AEL staff piloted the program in a West Virginia school district. By June 1991, revisions had been made and QUILT was ready for its first large-scale implementation.

Questioning framework. Questioning is widely accepted as the centerpiece of the teaching-learning process. Questioning is a powerful tool for teachers at all grade levels and in all disciplines. Good questions, effectively delivered, facilitate student learning as they serve to motivate and focus student attention, provide opportunities for practice and rehearsal, and function as yardsticks of how well students are mastering content. Further, questions stimulate students to process information at deeper levels. Questions hold the key to improving student learning and thinking. The QUILT program presents the questioning-answering-reacting processes as dynamic and interrelated systems whose parts interact to affect the outcomes of the teaching-learning transaction. (See the complete QUILT Model in Attachment #1.)

Research has informed us about effective questioning practice and, yet, as described in the bulleted items below, researchers have also documented that standard practice falls far short of the ideal.

- **Wait Time I**. Teachers require students to respond almost instantaneously to questions, allowing less than one second for students to think through their answers. However, in classrooms where teachers wait three to five seconds, students give longer responses, answer more frequently at higher levels of cognition, demonstrate more confidence in their answers, and ask more questions (McGlathery, 1978; Rowe, 1986).

- **Wait Time II**. Teachers react immediately to a student response, waiting an immeasurably short amount of time before providing feedback or making another instructional move. In classrooms where teachers wait three to five seconds after the initial student response, students answer more completely and more correctly; exhibit more speculative and inferential thinking; ask more questions; increase interactions with other students; and demonstrate more confidence in their responses (Rowe, 1974; Garigliano, 1972; Gooding et al., 1983).

- **Asking questions at all cognitive levels**. About 75 to 80 percent of the questions posed in both elementary and secondary classrooms are at the knowledge or recall level (Dillon, 1988; Gall, 1984; Haynes, 1935; McGlathery, 1978). However, when students are afforded opportunities to answer questions at higher cognitive levels, they demonstrate an ability to analyze, synthesize, and evaluate; they also score better on tests measuring recall and understanding of that content (Redfield & Rousseau, 1981).

- **Redirecting questions**. Teachers typically answer questions when students do not answer or do not give the answer the teacher was seeking. However, when teachers pose one question to multiple students, students are held more accountable for answering all questions; additionally, the interaction among and between students increases (Ornstein, 1988; Riley, 1981).

- **Designating a respondent**. Teachers frequently name a student to answer a question *before* posing the question. However, when teachers name a student *after* posing a question, all students are more likely to attend to the question and prepare a covert response (Gall, 1984; Ornstein, 1988).

- **Repeating student answers**. Teachers typically repeat student answers; however, when teachers do not repeat answers, students pay greater attention to and show increased respect for their classmates' responses (Ornstein, 1988).

Staff development framework. QUILT developers considered the design of the staff development *process* to be as critical to program success as that of content selection and sequencing. Hence, as they designed the program structure, they drew from the knowledge bases on change theory, organizational culture, effective staff development, andragogy, and related fields. QUILT recognizes that change begins with individuals, not organizations, and that changing one's behavior is difficult; embedded in the QUILT program are support structures to assist with this change.

- Program activities are phased over an entire school year acknowledging that change is a process—not an event—that occurs over time (Hord et al., 1987). Local QUILT facilitators receive training in the change process including the Concerns-Based Adoption Model (CBAM) so that they can better serve in the helping role to their colleagues.

- The QUILT program is intentional in its effort to construct a culture that promotes and sustains change. QUILT encourages the development of a shared vision, the use of symbols and metaphors, the development of a common vocabulary, celebration of successes, and other activities associated with culture-building (Deal and Kennedy, 1982).

- QUILT is consistent with staff development literature that maintains that teachers learn and improve performance when provided opportunities to: (1) acquire a knowledge base, (2) observe demonstrations, (3) practice new behaviors, and (4) receive feedback on their own performance in the classroom (Joyce and Showers, 1982). These four components are hallmarks of the QUILT program.

- All components of the QUILT program were crafted by reference to well established principles of adult learning. Two principal hallmarks are interaction with peers and individual reflection, considered to be the most important ingredients for successful adult growth and development (Levine, 1989). A major component of QUILT is self-assessment and personal goal setting. The design of the program incorporates a number of support structures for individuals seeking to change—not the least of which is a strong collegial association.

E. Features: How the Program Operates

Scope. QUILT offers the opportunity for an *entire faculty* to focus their growth and development for a *full year* upon a process central to all instruction: effective classroom question-

ing. While QUILT is complementary to all other staff development initiatives, it is designed to satisfy a school's inservice requirements for a year.

Curriculum and instructional approach. The content of the QUILT program is embodied in the QUILT Model (Attachment #1). Teachers participate in the following four instructional components:

- **Induction training**. This intensive, three-day (18-hour) training usually occurs as a preschool (August) session. Embedded in the induction experience are a presentation of knowledge and theory, demonstration of behaviors and skills, and many opportunities to apply and practice.

- **Collegiums**. Teachers attend seven 90-minute seminars over the course of a school year (see box below). These sessions, held every four to five weeks, provide opportunities to (1) share successes and problems related to the use of discrete questioning behaviors, (2) review specific content, (3) practice / apply associated skills and behaviors, (4) plan for classroom use, and (5) plan for work with a partner. Each collegium has a companion practicum comprised of partnering and individual classroom use.

- **Partnering**. At the beginning of the school year, each QUILT teacher is matched with a partner with whom to work as classroom implementation proceeds. Partners observe one another—using QUILT observation forms—and provide feedback. The observed partners demonstrate specified QUILT behaviors; hence, partners serve as "coaches."

- **Classroom implementation**. Teachers work independently to implement suggested strategies and, very importantly, to teach their students effective questioning processes.

Learner activities. The activities—which include a balance of interaction with peers and personal reflection—are targeted toward attainment of the purpose and objectives that are clearly stipulated for each segment. The seven collegium / practicum segments comprise the substance of the QUILT program. The objectives for each of these are shown in the box below.

Learning materials. Teacher materials for the complete QUILT program include: *QUILT Induction Manual*, seven individual teacher booklets (one for each collegium), multiple copies of five observation forms for partners' observations, *Teaching and the Art of Questioning* by J. T. Dillon (PDK Fastback 194), and set of seven teacher "cue cards" to assist with classroom implementation.

QUILT is a turnkey training program wherein each adopting school sends a training team to participate in a six-day training-for-trainers. The following materials support the efforts of the training team: *QUILT Induction Lecturettes, QUILT Collegiums and Practicums: A Facilitator's Guide, QUILT Readings*, eight videotapes for trainers, 149 transparencies (for use in induction and collegiums), camera-ready copy for QUILT poster quotes, and agendas and other handouts to support local implementation.

Staff activities and staffing patterns. The preferred model is for a school to designate three to five individuals to serve as a training team. This team should be comprised of teachers and at least one administrator. Time for teachers to attend the induction training and to participate in collegiums and partnering activities will need to be integrated into the school calendar. A coordinator, to assist with organization, scheduling, and resource management, is also needed.

Staff development activities. The designated training team attends a six-day training-for-trainers event that prepares them to deliver the three-day induction training, organize their

Collegium/Practicum Objectives

One: **Prepare to QUILT**—Objectives: (1) To renew my personal commitment to change through QUILT, (2) To decide what my students need to know about QUILT, (3) To emphasize to my students the importance of Wait Time I and Wait Time II.

Two: **Prepare to Partner**—Objectives: (1) To adopt the QUILT approach to partnering, (2) To observe and be observed using "Wait Times I and II—QUILT Observation Form", (3) To give and receive feedback; (4) To improve my use of wait times.

Three: **Improve Response Patterns**—Objectives: (1) To use my partner's feedback to enhance questioning and responding in my classroom, (2) To increase the number of response formats used in my classroom, (3) To eliminate any action zones that may be operating in my classroom, (4) To try out the "Round-robin Questioning" technique in my classes.

Four: **Create the Question**—Objectives: (1) To formulate questions with consideration of purpose and focus, (2) To formulate questions that engage student thinking at a variety of cognitive levels, (3) To work with my partner to analyze and classify my questions—using "Prepare the Question—QUILT Observation Form."

Five: **Polish the Question**—Objectives: (1) To phrase my questions so that my students are clear about what I am asking, (2) To write pivotal questions before asking them in class, (3) To work with my partner to revise and refine my written questions, (4) To teach my students how to question and respond at all cognitive levels.

Six: **Questioning for Discussion**—Objectives: (1) To be purposeful in the use of questions for recitation and discussion, (2) To know how to plan for and sustain class discussion, (3) To know and use alternatives to the asking of questions during class discussions, (4) To teach students about the differing purposes of recitations and discussions, (5) To observe and be observed using "Teacher Reactions During Discussion—QUILT Observation Form."

Seven: **QUILTing**—Objectives: (1) To assess my use of QUILT behaviors, (2) To reflect upon the benefits of the QUILT program for improving learning and thinking in my classes, (3) To commit to continued use of QUILT in my classes, (4) To observe and be observed using "Process Student Responses—QUILT Observation Form."

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school for implementation, and facilitate the first two collegiums. A one and one-half day "booster" training-for-trainers session brings the training teams back together for additional facilitation training (including change facilitation) and training in delivery of collegiums 3-7. These training-for-trainers events are cofacilitated by Walsh and Sattes, codevelopers of QUILT. Local trainers receive training in generic facilitation and presentation skills. The majority of teachers comprising past training teams had little to no prior experience presenting workshops. Maximum number of participants for training-for-trainers events: 50.

Management activities. A local coordinator should be designated to: (1) schedule induction and collegiums; (2) arrange for stipends to school trainers (and to teachers, if possible); (3) arrange college course credit and/or inservice credit; (4) facilitate the matching of partners; (5) support partnering activities (e.g., obtain substitute teachers so that partners can observe and engage in feedback conferences six times during the year); (6) handle arrangements for training sessions including space, refreshments, supplies, etc.; and (7) communicate with AEL QUILT project staff.

Monitoring and evaluation procedures. QUILT requires that adopting schools collect and forward participant evaluations of induction training and of each collegium. The most significant type of project assessment is completed by the teachers themselves as they engage in cross-observations with their partners using QUILT observation instruments.

F. Significance of Program Design as Compared to Similar Programs

An extensive review of literature and dialogue with colleagues across the nation uncovered a plethora of programs designed to improve classroom questioning. (See Attachment #2 for annotated listing.) Most of these were one-shot workshops (one hour to three days in length) that had no provision for followup or evaluation of results. None of them go beyond presentation of research-based content to the design of a program structure that would assist teachers in changing over time. QUILT developers concluded that while the literature review provides testimony to the widespread concern and interest in classroom questioning, it also confirms that there is no long-term program that has amassed evaluation evidence to demonstrate that it makes a difference in teacher performance in this area. QUILT appears to be unique in both these regards.

Potential for Replication

A. Settings and Participants (Development and Evaluation Sites)

Nearly 400 teachers from 13 schools in 13 school districts participated in the 1991-92 field test of the QUILT program. Included were 163 teachers in three large, comprehensive high schools (two in Kentucky and one in Virginia); 34 teachers in a junior high school (in West Virginia); and 159 teachers in eight elementary schools (three in Tennessee, one in Virginia, and four in West Virginia). Additionally, 41 secondary teachers participated from Fort Knox Community Schools [a section VI, U. S. Department of Defense (DOD) unit]. As a total group, these teachers had an average of 14 years of teaching experience; 75 percent were female; 95 percent were Caucasian; 42 percent were 40-49 years of age; and 40 percent had a bachelor's as their highest degree. The lack of ethnic diversity in the teachers mirrors the population of their communities and the Appalachian portion of the four-state Region served by AEL.

Teachers at all grade levels (K-12) and 20 different secondary content/subject areas implemented QUILT over the 1991-92 school year. Ten percent (10%) of the total were in special/exceptional education. While approximately two-thirds of the secondary teachers instructed in the core academic subjects, other participants taught electives including computer courses, foreign languages, art, physical education, and the vocational-technical fields. At least two schools successfully included teacher aides in their implementations. The total included 11 public schools from 11 different school districts; one parochial school, from the Diocese of Wheeling-Charleston, West Virginia; and the DOD school in Fort Knox. The public and parochial schools reflect the population of the Appalachian Region—predominantly rural, Caucasian, working class in nature; the DOD school has greater racial and cultural diversity.

Vignettes (shown in the box below) of three participating schools characterize the nature and diversity of the Region and the client groups served.

Rustburg High School, Campbell County, Virginia: This school serves 850 students in a stable, blue-collar community of 50,000 residents. The high school diploma is the highest degree attained by 64 percent of the parents of Rustburg; 22 percent of the parents did not complete high school. Approximately 26 percent of these students go on to college after spending all four years (grades 9-12) at this high school; the dropout rate is 7 percent. About 16 percent of the students are African-American.

East Bank Junior High School, Kanawha County, West Virginia: 580 students (grades 7-9) attend this school where the attendance rate was 87 percent and the dropout rate 13 percent during the 1991-92 school year. Ninety-five percent (95%) of the students are Caucasian; 50 percent receive free and reduced lunches; 50 percent come from one-parent homes. Only 50 percent of the students have telephones in their homes, one clue to the relatively low socioeconomic status of the majority of students served by this school.

Bel Aire Elementary School, Tullahoma, Tennessee: 375 elementary students (grades K-6) attend this school operated by the small, independent city district located in this small town (17,000 population). Ninety-five percent (95%) of the town's population came from elsewhere in the nation to this community, whose students have a high level of education. The per capita income of the county is $14,028; 32 percent of the Bel Aire students qualify for free/reduced lunches.

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QUILT was developed for the total universe of teachers—serving students of all ability levels and backgrounds in all grades and subject areas. While the teachers and students who participated in the field test were neither urban nor racially diverse, this does not mean that the program will not serve the needs of urban educators equally well. The majority of the research on effective questioning that informed development of the QUILT model was conducted in urban settings, often with at-risk students. Additionally, QUILT developers were sensitive to the broader issues of diversity in materials and workshop designs.

B. Replicable Components and Documentation

All elements of QUILT are transportable. The 13 schools in the field test successfully implemented QUILT during 1991-92, as did 21 school teams in the succeeding two years (1992-93 and 1993-94).

C. User Requirements and Costs

The costs and requirements for implementing the QUILT program are outlined in Table 1 on the next page. The first column identifies a timeline and costs for each adopting school. Additional costs to the school or district are listed in the final column, "Optional Incentives." No price is attached to these optional incentives because costs would vary from district to district; many districts are successful in having some of these services donated by local community businesses. None of these "optional incentives" is *required* to implement QUILT; however, each of them contributes to the success of the program, we believe, by giving recognition and rewards to the trainers and teachers who participate.

The second column describes timeline, responsibilities, and costs for each trainer. QUILT is implemented at the local school by a team of trainers who are trained by QUILT developers. Column 3 lists the requirements and costs associated with individual participating teachers. (For a review of how the program operates, see also a previous section of this document, "Features: How the Program Operates.")

Evidence for Claim 1

A. Claim 1: Significant Increase in Teacher Knowledge and Understanding of Effective Classroom Questioning

After one year's participation in the QUILT program, teachers in 13 schools showed significant gains ($p=0.0001$) on a project-developed instrument, Questionnaire on Effective Classroom Questioning (Cronbach's alpha = 0.76), designed to measure knowledge, understanding, and application of selected concepts related to effective classroom questioning. These teachers also scored significantly higher than teachers in two alternate treatment groups.

B. Description of Methodology for Claim 1

1. **Design.** The design was a randomized, pre-post, comparison group design—sometimes referred to as a mixed between and within subjects design. A total of 1,178 teachers from 42 schools in 13 school districts were the subjects of a four-state field test of the QUILT program that spanned the 12-month period of May 1991-May 1992. District superintendents identified at least three schools that were interested and willing to take part in this field test. In 12 of the districts, faculty participation was mandatory, and whole faculties participated in the assigned treatment. In Fort Knox, teachers from three schools volunteered to participate in the treatment of their choice.

The between-subjects' independent variable was treatment condition (i.e., the type of staff development provided). Under this particular design, subjects involved in the QUILT program constituted the experimental group; other subjects were assigned to one of two more traditional staff development experiences (treatment groups). Because of limited resources, the field test did not include a no treatment group. Highlights of the three treatments follow.

QUILT (Condition A): Teachers participated in all four components of the QUILT staff development program over an entire school year—including a three-day (18-hour), preschool induction training; seven collegiums; seven practicums—seven opportunities to observe, be observed, and engage in feedback conferences with one's partner; and individual study and classroom applications.

Induction only (Condition B): Teachers participated in one component of the QUILT program—the three-day induction training. No additional training or support was provided.

Awareness (Condition C): Teachers attended a three-hour inservice session on the topics contained in the QUILT Model for classroom questioning. Of necessity, the content was condensed and presented in a more didactic manner than in the three-day induction training.

The program evaluator randomly assigned one school from each district to each of these three treatments. The evaluator had no information concerning the schools other than the school names. One consequence of the random assignment of schools was a slightly unequal group size across the three conditions. Three hundred and ninety-seven subjects taught in the Condition A schools; 326 in the Condition B schools; and 455 in Condition C schools.

QUILT codevelopers designed the materials and workshops for all three treatments. Local facilitator teams—trained by QUILT codevelopers in a six-day training-for-trainers—delivered the three-day induction training to Condition A and Condition B teachers using the *QUILT Induction Manual* and complementary materials. These same facilitator teams delivered the awareness session to Condition C teachers using special manuals prepared for this purpose. Post-workshop evaluations indicate that the goal of providing quality experiences to each of the three groups was achieved. See Attachment 3 for a complete listing

Table 1
QUILT Implementation Costs and Requirements, 1994-95

Requirements for School

January 1994
Provide information about QUILT to school faculties. Because the QUILT program requires a large commitment of time and energy, districts should work collaboratively with schools to decide about the implementation of QUILT.

February 1, 1994
Completed applications are due to AEL.

April 1994
Select school training team (two to five members). Support preparations for QUILT at the school.

June 1994
Sponsor the school trainers to the 6-day training-for-trainers in Lexington, KY.

August 1994
Sponsor the induction workshop for school faculty. Provide support to the school trainers for a successful induction.

September 1994-May 1995
Provide support to the school training team for implementing collegiums and partnering activities throughout the year.

November 1994
Sponsor travel costs for the school training team to attend a 2-day booster.

Cost: $250 per school for materials.
Includes eight videotapes for trainers, complete set of more than 100 training transparencies, and camera-ready copy for QUILT poster quotes. (See last column for optional incentives to provide for teachers and trainers.)

Requirements for School Trainers

Local teacher trainers—not outside "experts"—facilitate the QUILT training and implementation. QUILT staff train these local trainers at two events. Each school training team should consist of two to five trainers, depending on the size of the school and the number of teachers who plan to participate.

June 19-24, 1994—Lexington, KY
Participate in an intensive, 6-day training-for-trainers, which incorporates the QUILT induction and an overview of the entire QUILT program.

August 1994
Plan and conduct the 3-day QUILT Induction Workshop for their school faculty.

September 1994-May 1995
Lead the seven collegiums, which are 90-minute meetings during which teachers review one critical component of QUILT, and share successes and problems in implementing QUILT with students.

Facilitate teacher efforts to partner and implement in the classroom.

November 1994—Lexington, KY
Attend a 2-day booster. Focus will be on school trainers' role as facilitators of the change process within the school.

Cost: $625 per trainer *plus* travel to training events, lodging, and additional meals.
The $625 includes registration fees for two training events (eight days), a complete set of trainer materials, refreshments, and lunches. Each trainer receives the following materials: *QUILT Induction Manual, Induction Lecturettes, Collegiums and Practicums: A Facilitator's Guide, QUILT Readings*, seven collegium booklets, PDK Fastback by J. T. Dillon, a QUILT logo made from felt pieces, and seven teacher aid ("Q") cards, as well as agendas and other support materials necessary for conducting QUILT induction training.

Requirements for Teachers

August 1994
Participate in the intensive, 3-day QUILT Induction Workshop led by school trainers. This highly interactive training forms the knowledge base for successful implementation of QUILT.

September 1994-May 1995
Implement QUILT in the classroom.

Attend seven 90-minute collegiums. In each collegium, review one critical component of QUILT, share successes, discuss problems, and renew commitment to QUILT processes.

Observe a QUILT partner at least six times during the year.

Be observed by a QUILT partner at least six times during the year.

Meet with your QUILT partner after every observation to give or receive feedback.

Review QUILT materials as needed through individual study and reading.

Cost: $25 per teacher for complete materials.
Includes ar *Induction Manual*, seven collegium booklets, PDK Fastback by J. T. Dillon, a QUILT logo made from felt pieces, and seven teacher aid ("Q") cards.

Optional Incentives

QUILT is a comprehensive staff development program. The basic costs are outlined in the first three columns. However, some districts and schools choose to provide incentives to teachers and trainers. Examples of incentives that have been provided by QUILT districts include the following:

Stipends to school trainers
—for attending the two training-for-trainers events,
—for planning and conducting the 18-hour induction workshop, and
—for planning and facilitating the yearlong QUILT staff development program.

Stipends to teachers—for participating in the yearlong QUILT staff development program.

Course credit—from a college or university for participating teachers.

Inservice credit—to teachers and trainers for participation.

Meals and refreshments—for faculty during the 3-day induction training and the seven after-school collegiums.

Early release—for teachers to attend the seven 90-minute collegiums.

Substitute teachers—so that teachers can observe partners six times during the year on released time.

Miscellaneous supplies—for the training.

Off-campus training facility—particularly for the 3-day Induction Workshop.

of participating districts and schools and Attachment 4 for a summary of workshop evaluation data for the three conditions.

The within-subjects' independent variable was time between administration of the pretests and the posttests. The pretests were administered prior to program implementation (Spring 1991); posttests were given at the end of the year (Spring 1992). The same battery of pre- and posttests was administered to teachers in all three treatment groups at the same time.

This particular design helped address the three major questions driving this research study: (1) How effective is the QUILT staff development program? (2) Does participation in the QUILT program have a positive impact on classroom questioning? (3) Compared with two more traditional kinds of inservice programs, is the complete, yearlong QUILT staff development program more effective? The pre-post design was appropriate for addressing the first two of these questions; the comparison group design was needed to address the third question.

2. **Sample for Claim 1.** The Questionnaire on Effective Classroom Questioning (QECQ) was administered to the total population of 1,178 (K-12) teachers in 42 schools. (See "Settings and Participants" for a complete description of participants.)

3. **Instruments and Procedures Used for Claim 1.** The QECQ measures teacher knowledge about and understanding of classroom questioning and its relationship to student learning and thinking. Project staff developed this instrument after an extensive search failed to turn up an existing instrument. Criteria for acceptance of this instrument included: correspondence between content of test items and content of QUILT; a sufficient degree of difficulty to yield a reasonable level of score variability needed to assess pre- to posttest change; and an acceptable level of reliability.

This 49-item multiple choice instrument does have high content validity. The first version of the QECQ had 30 items; internal consistency reliability was 0.63. The developers revised problematic items and added new items to address additional content areas. In its final form, Cronbach's alpha = 0.66 on pretest; alpha = 0.76 at posttest administration when teachers are more knowledgeable about the content of the instrument.

The 49 items are distributed on six subscales: effective questioning (general concepts), 6 items; teacher feedback and reaction, 15 items; discussion vs. recitation, 5 items; respondent selection and response formats, 7 items; cognitive levels, 9 items; and wait times, 7 items.

4. **Data Collection.** Each district named a staff person to coordinate local data collection activities. In March 1991 and again in March 1992, these 13 persons were trained by QUILT staff. To assure consistency across sites, AEL produced an instructional videotape to be shown at the time instruments were administered.

Teachers in each of the 42 schools met as whole groups to complete the QECQ following instructions given on the videotape. Each teacher used a special six-digit code to assure anonymity. The codes were entered on a scantron along with answers to the 49-item QECQ. Coordinators were instructed to collect all instruments and scantrons and place them immediately into envelopes, which were sealed in the teachers' presence and mailed. At AEL, the scantrons were examined, cleaned up as needed (stray marks erased and answers clearly recorded), scanned, put onto disk, and mailed to the project evaluator. The evaluator checked each record for unusual results; AEL staff matched data against original scantrons for all questionable instruments.

5. **Data Analysis.** The following analyses were conducted:

a. Univariate summary statistics were computed for pretest results, posttest results, and pre-posttest results. Included were tests for normality and provision of data for computation of Fmax statistics for checking analysis of variance assumptions. These results were used to compute effect sizes. The pretest standard deviation for participant scores in all three groups was used as the base for the effect size. The posttest minus pretest means were divided by the overall standard deviation to obtain the effect size.

b. The General Linear Model (GLM) Analysis of Variance was used because of unequal group sizes. The GLM procedure was conducted as a mixed design, with a between subjects factor (condition) and a within subjects factor (testing time). Of primary concern were two planned followups of the interaction. Since these comparisons were in the planned mode, the significant interaction of condition and time was not required to conduct these followups.

c. The first followup procedure involved the comparison of pre- and posttest means within each condition. These were compared using directional, dependent *t* tests with alpha set at 0.05.

d. The second followup procedure involved the comparison of posttest means of Condition A with each of the other groups (A with B and A with C). These were compared using directional, Dunnett *t* tests with alpha set at 0.05. The Dunnett is specifically designed to compare groups with a control group or the situation where all groups are compared with only one other group. Dunnett controls Type I error rate in an experiment-wise manner. It is one of the few planned followup procedures that can be used to test directional hypotheses. Thus, it has high statistical power,

Note: Table 2 and Figure 3 include only teachers for whom AEL received completed, usable pre- *and* posttest QECQ. Because it was the end of the school year, some failed to administer the posttest. Others were lost because of incorrect codes or loss/transfer of teachers over 12 months.

Table 2
Pre- and Posttest Comparisons on Questionnaire on Effective Classroom Questioning (QECQ), Percent Correct

Alternative Treatments										
Condition A N = 297			Condition B N = 200			Condition C. N = 292			Group Differences in Means*	
Pre	Post	p	Pre	Post	p	Pre	Post	p	Post Scores	Changes from Pre-Post
46.8	58.2	<0.001	47.2	53.4	<0.001	45.1	47.4	<0.001		
SD 10.3	12.3		9.7	12.7		9.1	10.5		A>B A>C	A>B A>C
Effect Size		1.17			0.64			0.24	*p<0.05	

but is limited to the number of groups, minus one, pairwise comparisons.

e. The third followup procedure involved the comparison of the pre- to posttest change mean of Condition A with each of the other groups (A with B and A with C). These were compared using directional, Dunnett *t* tests with alpha set at 0.05.

C. Description of Results for Claim 1

Teachers who participated in the QUILT program (Condition A) significantly increased their knowledge and understanding of the research base undergirding effective classroom questioning. In fact, even those teachers receiving content via alternate treatments (Conditions B and C) showed a significant increase in their composite scores—confirming the content validity of the QECQ and the effectiveness of all three workshop designs. Table 2 shows the pre- and posttest mean scores for all three conditions, illustrating that each condition had significant within group pre- to posttest differences.

The pre- to posttest change for Condition A teachers was, however, much greater than those for the other two conditions as evidenced by the effect sizes: for Condition A, the effect size was +1.17, clearly higher than those for Condition B (+0.64) and Condition C (+0.25).

QUILT (Condition A) teachers' pre- and posttest scores for the six subscales of the QECQ are illustrated in Figure 1. This figure clearly depicts the significant pre- to posttest mean changes within Condition A on all six subscales and the total score. The complete statistical table of pre- and posttest scores for the six subscales for all three treatment groups appears as Attachment 5. Effect sizes range from 0.36 to 1.30.

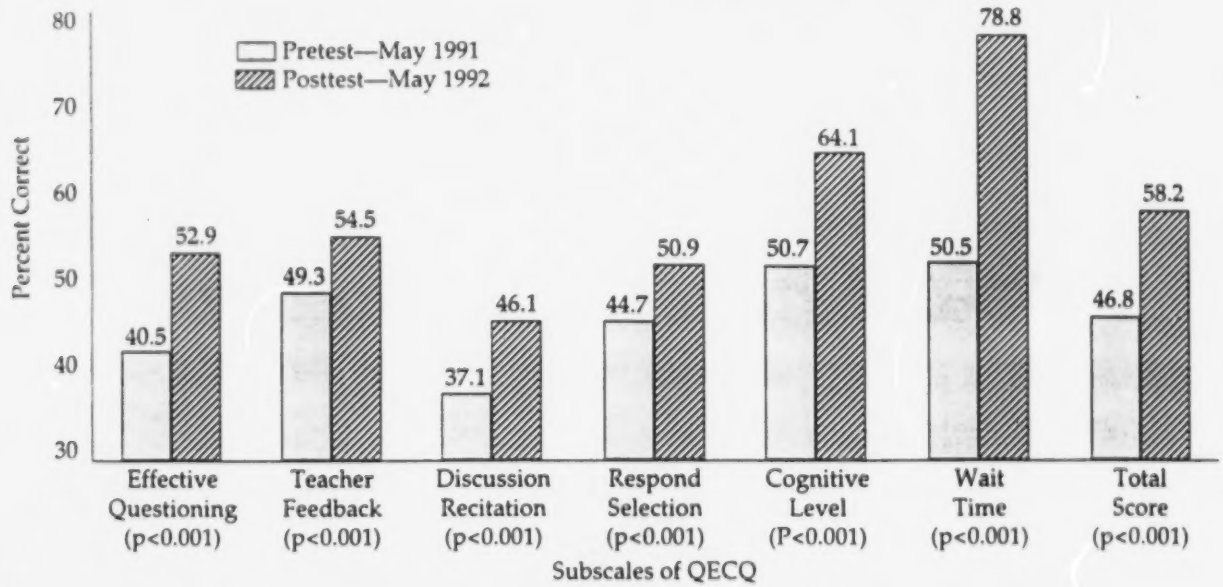


Figure 1. Pre- and Posttest Comparisons of Condition A Teachers' Performance on QECQ, Percent Correct by Subscale

When comparing Condition A posttest means with the posttest means of the other two groups, Condition A had significantly higher means than both Conditions B and C on the total score. Condition A teachers scored significantly higher than Condition B teachers on three of the subscales and significantly higher than Condition C teachers on all six subscales. When comparing pre- to posttest change, the change for Condition A teachers was significantly higher than the change for Condition B teachers on three of the subscales and on the total score; the Condition A teachers had a significantly higher pre- to posttest change than did Condition C teachers on all subscales as well as on the total score.

Analysis of the QECQ data yields strong evidence in support of Claim 1: teachers who participate in the QUILT staff development program significantly increase their knowledge and understanding of effective classroom questioning.

D. Summary of Supplementary Evidence for Claim 1

By self report, teachers receiving QUILT training increase their knowledge of effective questioning. Following the QUILT induction training, 340 teachers in Condition A rated personal knowledge gain on each of 14 specific content areas, using the rating scale: 1 = None to 5 = Very Much. The means for the 14 items was 4.1. Four items had means above 4.2: wait time II (4.5), wait time I (4.3), QUILT Model (4.3), and recitation vs. discussion (4.2). A summary of these results appears in Attachment 4. Clearly, respondents felt they had gained in knowledge.

Evidence for Claims 2 and 3

A. Claim 2: Significant Increase in Teacher Use of Effective Questioning Practices

A random sample of teachers from 13 schools was videotaped before and after participation in the QUILT program. Using a project-developed instrument, Classroom Questioning Observation Instrument (rater reliability >0.90), trained coders documented teacher use of discrete questioning behaviors targeted by the QUILT program. Teachers showed significant, positive changes in their use of the following seven behaviors:

- decrease in number of teacher questions ($p = .001$)
- use of wait time I ($p = .008$)
- use of wait time II ($p<.001$)
- percent of questions at higher cognitive levels ($p = .033$)
- redirection of questions ($p = .009$)
- designation of respondent before question ($p = .005$)
- decrease in repetition of student answers ($p = .03$)

Additionally, teachers in the QUILT program performed significantly better than did teachers in at least one of the alternate treatment groups in their use of the first four behaviors listed above.

Claim 3: Significant Increase in Student Thinking at Higher Cognitive Levels

Student answers to teacher questions were at cognitive levels above simple recall significantly more often ($p = .04$) after their teachers participated in the QUILT program. The responses of these K-12 students, who were in the classrooms of the random sample of teachers videotaped, were coded using the Classroom Questioning Observation Instrument (rater reliability >0.90).

B. Description of Methodology for Claims 2 and 3

1. Design. (Same as design for Claim 1.)

2. Sample for Claims 2 and 3. A special sample consisting of 150 teachers—50 each from Condition A, Condition B, and Condition C was drawn at random. Teachers in this special sample were selected as subjects to be videotaped for 15 minutes of a lesson in which questioning was the intended, primary instructional method. The sample represented approximately 12 percent of the total population, an intentional oversampling to compensate for the attrition that would likely occur between pre-QUILT and post-QUILT observations. The sample was extremely representative of the total population. Fifty-four percent (54%) of the sample (and 58 percent of the total population) taught at the secondary level. Seventy-five percent (75%) of the sample was female, compared to 77 percent of the total group; 96 percent were Caucasian, compared to 95 percent of the entire population; and 14 percent were ages 50-59, while 13 percent of the universe in this study were in this age bracket. The sample also matched the total population with regard to educational background and years of teaching experience, with 42 percent in the sample holding a bachelor's degree as their highest academic degree compared to 40 percent of the entire group. Sixteen percent (16%) of both the sample and the whole group had 5-9 years of teaching experience. The mean number of years taught by teachers in the sample was 13; by the total population of teachers, 12.

3. Instruments and Procedures for Claims 2 and 3. The instrument used in connection with Claims 2 and 3 is the Classroom Questioning Observation Instrument (CQOI), which assesses teacher and student use of effective questioning practices from videotaped classroom excerpts. Developed by an external consultant who was trained and experienced in classroom observation and data collection, the instrument has high content validity. The CQOI is a low-inference, multiple-code category-system observation instrument. The behaviors coded exactly matched the observable behaviors taught in the QUILT program; definitions for coded behaviors were reviewed and validated by QUILT developers. Four middle and high school teachers were selected and trained as coders. Training emphasized accuracy in coding classroom questioning behaviors and responses; speed was not an area of concern since coders could replay videotapes. Coders' reliability following the 15-hour training and independent work sessions ranged from 90 percent to 94 percent, at least matching the previously determined level of acceptability (.90). Individual coder reliability was determined by comparing their coding with a criterion videotape previously coded by the CQOI developer-coder trainer.

Potential for coder bias was controlled; coders were not trained in the QUILT program, never met the QUILT program developers, were unfamiliar with the research

design, and were blind to the treatment conditions of any videotaped teacher.

4. Data Collection for Claims 2 and 3. The names of teachers randomly selected by AEL staff to be part of the special sample for videotaping were given to district coordinators. The local coordinator contacted individuals and asked them to participate by being videotaped for a 15-minute segment in which questioning was the primary method of instruction. Videotaping for the pretest took place in April and May 1991; post-treatment videotapes were filmed in April and May 1992. The number of teachers for whom both pre-QUILT and post-QUILT videotapes were obtained was 37 (A), 28 (B), and 39 (C). Teachers received written instructions about the videotape, including a rationale for the research effort. A copy of "Teacher's Instructions" is included in Attachment 6.

5. Data Analysis. The same statistical procedures were used to analyze these data as were used in the analysis of data for Claim 1.

C. Description of Results for Claim 2.

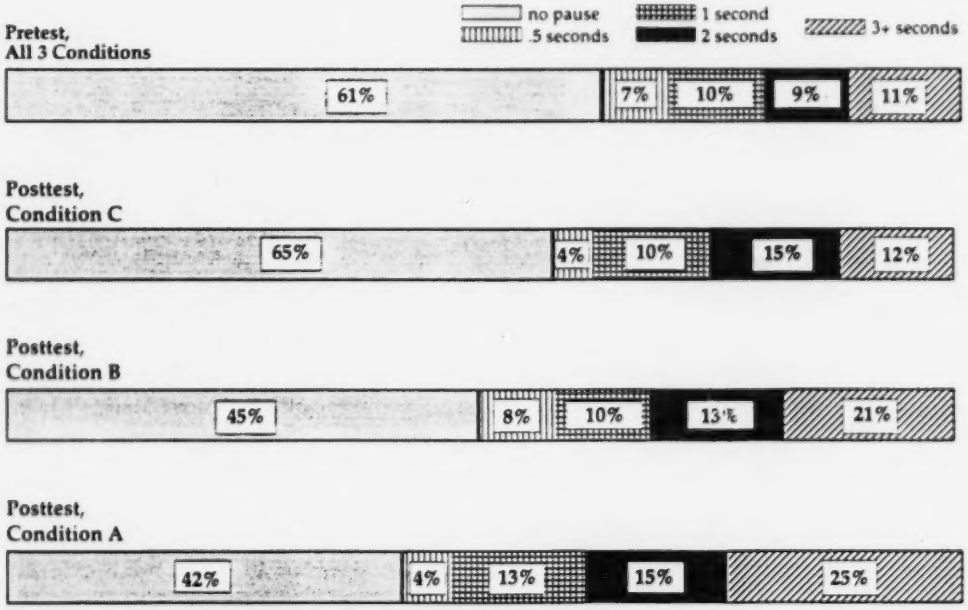
Seven teacher variables are reported from the CQOI. These data, summarized in Table 3, clearly demonstrate an increase in teacher use of effective questioning practices. For Condition A, pre- to posttest changes for all of the variables had effect sizes of 0.4 or greater. There were statistically significant pre- to post-differences at $p < 0.05$ on all variables for Condition A. For both Conditions B and C, there was only one variable with an effect size greater than 0.4. In Condition B, teachers made only one significant change pre- to posttest; whereas, teachers in C made two significant changes.

Teachers showed significant, positive changes in their use of seven behaviors. The reader is referred to an earlier section, "Background, Foundation, and Theoretical Framework," in this document for brief summaries of research about each of the following behaviors.

1. Number of Questions. Condition A teachers decreased the number of questions asked from a mean of 41.4 to 31.0 ($p<0.001$), with an effect size of -0.65.

2. Wait Time I. Teachers significantly increased their use of wait time I—pausing for at least three seconds after the asking of a question. Before QUILT, Condition A teachers waited the prescribed three seconds following only 12.8 percent of the questions posed; after QUILT, they paused at least three seconds following 25 percent of questions asked—almost doubling their use of wait time I. The effect size for the pre- to posttest change in wait time I was 0.99. Not only did Condition A teachers increase significantly in meeting the wait time I criterion, they made significant movement toward meeting the wait time I criterion as illustrated in Figure 2. As shown in Figure 2, teachers had more than a 20 percent decrease in the percent of questions after which they had no pause. Additionally, this figure graphically contrasts Condition A teachers' gains with those of the other two treatment groups. Both Table 3 and Figure 2 provide convincing evidence of the effectiveness of the Condition A treatment when compared to the two alternate treatments. (See Attachment 7 for complete statistical data underpinning Figure 2.)

3. Wait Time II. Even more impressive gains were realized in QUILT teachers' use of wait time II where the effect size was 1.72. Notice that teachers in the other two treatment groups made no significant gains in this area. Again,



NOTE: May not equal 100% because all percentages are rounded to the nearest percentage; no decimals are used.

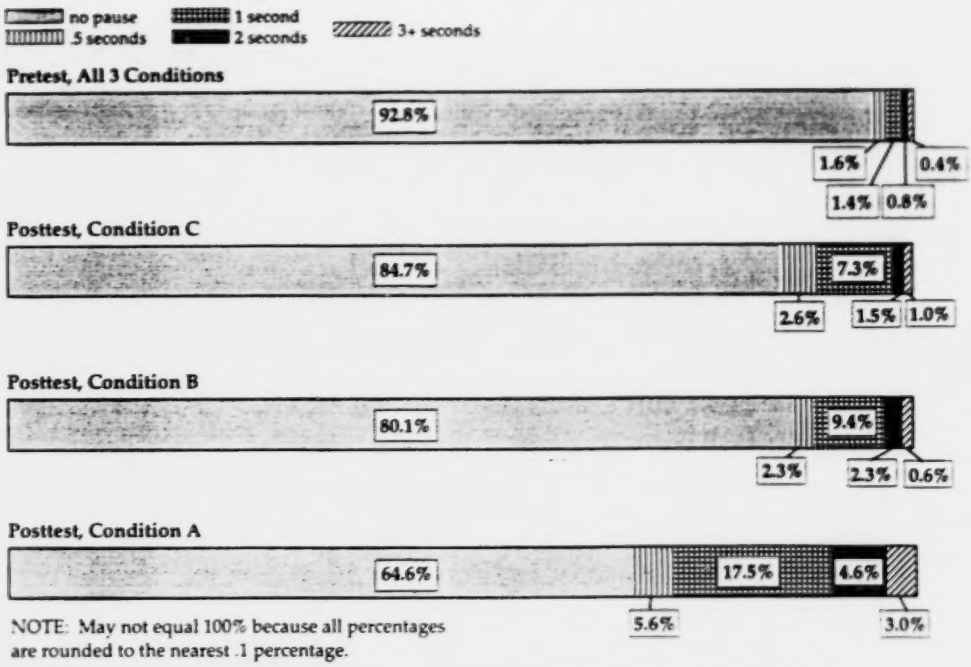
Figure 2. Wait Time I: Percentage of Questions After Which Teachers Pause for Times Ranging from a Half Second to at Least Three Seconds

Table 3
Pre- and Posttest Comparisons of Observational Data
1991-92 Field Test of QUILT

Variable	Condition A N = 37					Condition B N = 28					Condition C N = 30					Group Difference in Means*	
	Mean					Mean					Mean						
	Pre	Post	p	Sig.	ES	Pre	Post	p	Sig.	ES	Pre	Post	p	Sig.	ES	Post	Change
# of Teacher Questions[1]	41.4 SD 15.8	31.0 14.5	<0.001	+	-0.65	44.9 17.4	40.5 13.8	nsd		-0.27	43.3 15.5	36.3 14.4	<0.05	+	-0.44	A<B	
Wait Time I—% at 3 or more seconds	12.8 SD 11.9	25.0 24.9	<0.01	+	0.99	11.1 10.1	20.7 19.5	<0.01	+	0.78	10.1 14.8	11.5 16.5	nsd		0.11	A>C	A>C
Wait Time II—% at 3 or more seconds	0.52 SD 1.28	2.98 6.73	<0.05	+	1.72	0.10 0.51	0.59 1.61	nsd		0.34	0.59 2.06	0.97 4.57	nsd		0.26	A>B A>C	A>C
Cognitive level of Question— % above recall	31.0 SD 23.3	41.2 27.8	<0.05	+	0.43	41.0 24.8	39.2 30.1	nsd		-0.07	26.3 22.0	32.0 22.7	nsd		0.24		
Question redirected to another student—%	14.1 SD 14.5	23.2 19.9	<0.01	+	0.59	20.6 16.7	19.4 14.9	nsd		-0.08	18.1 15.0	12.3 14.5	nsd		-0.37	A>C	A>B A>C
Student designated after question—%	84.1 SD 12.8	90.8 9.3	<0.01	+	0.59	83.1 23.2	85.3 11.2	nsd		0.13	83.5 14.4	89.4 11.2	<0.05	+	0.35	A>B	
Teacher repeats student answer[1]	62.4 SD 18.9	54.6 28.5	<0.05	+	-0.43	60.5 14.3	55.9 17.9	nsd		-0.25	59.4 20.9	61.5 25.5	nsd		0.11		

*= p<0.05
[1]=Predicted, desired direction of change for these variables is negative.
Sig.=Significant
ES=Effect Size

the graphic display (Figure 3) of the more discrete changes in wait time II shows additional development in the desired direction, with a very substantial and highly significant decrease in the no pausing behavior following a student response. (See Attachment 8 for data related to Figure 3.)



NOTE: May not equal 100% because all percentages are rounded to the nearest .1 percentage.

Figure 3. Wait Time II: Percentage of Questions After Which Teachers Pause Following Student Response

4. Cognitive level of question—percent of questions above recall. Every question posed on the videotapes was coded into one of three cognitive levels, using a simplified version of the Bloom taxonomy: Recall, Use (Understanding, Application, or Analysis), or Create (Synthesis or Evaluation). QUILT teachers showed a significant increase in the percent of questions posed at cognitive levels above recall, with an effect size of 0.43. Again, the other two treatment groups showed no significant difference pre- to posttest. The increase for Condition A teachers was in their questioning at the highest cognitive level, create (synthesis and evaluation on the Bloom Taxonomy). Certainly there is a linkage between teacher improvement in higher level questioning and student responding at higher levels of thinking (Claim 3 below).

5. Question redirected to other students. The percentage of time that Condition A teachers asked one question of more than one student increased almost 10 percent ($p<0.01$) following a year in QUILT—with an effect size of 0.59. There were no significant changes pre- to posttest for the other two conditions; in fact, there was an actual decrease in the percentage of times that these teachers used this questioning strategy.

6. Student designated after question. Prior to the QUILT program, teachers in Condition A followed this procedure 84.1 percent of the time, leaving relatively little room for improvement. All the more impressive, then, is the almost 7 percent gain to 90.8 percent, ($p<0.01$) and the effect size of 0.59.

7. Teacher repeats student answer. This frequently used and difficult to change behavior did not, in fact, significantly change for teachers in Conditions B and C. However, teachers who participated in the QUILT program did significantly decrease their repetitions of student responses ($p<0.05$); the effect size was -0.43.

C. Description of Results for Claim 3

Table 4 summarizes the data related to the cognitive levels of student responses. (Student responses were coded into one

Table 4
Pre- and Posttest Comparisons of Observational Data, 1991-92 QUILT Field Test.
Percentage of Student Responses Above the Recall Level

	Condition A n = 37 teachers				Condition B n = 28 teachers				Condition C n = 30 teachers			
	Pre	Post	p	ES	Pre	Post	p	ES	Pre	Post	p	ES
	28.4	37.6	<0.05	0.41	38.2	35.9	nsd	-0.10	25.2	29.6	nsd	0.19
SD	21.7	25.4			23.3	28.5			21.8	20.4		

ES=Effect Size

of three cognitive levels, as were teacher questions.) Almost 10 percent more of student answers to QUILT-trained teachers' questions were at a higher cognitive level following their teachers' yearlong participation in the QUILT program ($p<.05$). The effect size for this student change, pre- to posttest, was 0.41. This percentage increase closely mirrors Condition A teachers' percentage increase in the asking of higher level questions—suggesting that teacher questioning affects student thinking. The student data from the sample in Conditions B and C indicated no significant difference pre- to posttest; the level of student responses for these groups also related closely to the level of teacher question.

D. **Interpretation and Discussion of Results**

1. **Relationship between effect and treatment.** The knowledge and behavior gains experienced by teachers who participated in the QUILT program were substantial and significant. Not only did these teachers significantly increase their knowledge and understanding of effective questioning practices, they translated this knowledge (theory) to practice. QUILT teachers showed significant growth and development in their use of seven identified questioning behaviors including rate of questioning, use of wait times I and II, questioning at higher cognitive levels, redirection of questions, designation of respondent after asking of question, and decrease in repetition of student answers. These changes in questioning procedures and techniques are attributable to teacher participation in the seven collegiums, seven observation and feedback conferences, and individual application components of the QUILT program. Failure of teachers in the other two treatment groups to make as many significant changes in their use of these identified behaviors—in spite of the fact that both groups significantly increased their knowledge in this area—is strong evidence to support the yearlong QUILT treatment. Even those teachers who participated in the intensive, three-day QUILT induction did not change significantly in six of the seven variables. When teachers do not have long-term opportunities for demonstrations, practice, and feedback as they seek to change deeply entrenched behaviors, they are unable to change these routinized patterns. The collegiums and partnering experiences provided these opportunities. Additionally, these components provided reinforcement and support to these subjects who were attempting significant change.

A related, and ultimately the bottom-line, goal of the QUILT program is to enhance student thinking. Students in classrooms of QUILT-trained teachers significantly increased the percent of their responses at higher levels of cognition pre- to posttest. This hoped-for outcome can be directly linked to a number of changes in teacher behavior; it can be indirectly linked to other features of the QUILT treatment. As teachers asked more questions at higher levels, students provided more answers at higher cognitive levels. In addition, teacher use of wait times I and II provided more time for student thinking prior to and during the answering of a question; this is also related to student responding at higher levels of cognition. Finally, as a part of their individual study and application, QUILT teachers teach their students to think about their questioning and answering; more specifically, they teach students what is called for in a response at the higher levels of cognition.

2. **Control of Rival Hypotheses.** Rival hypotheses to the claims relate to four types of validity: (a) statistical conclusion, (b) internal, (c) construct, and (d) external. Space does not permit a discussion of the more than 30 recognized threats to validity; however, project evaluators made a conscious effort to control or minimize each through the evaluation design and methodological considerations.

(a) To ensure statistical conclusion validity, data analysis assumptions were checked; planned, directional hypotheses were used; methods selected had high statistical power; methods accounted for unequal group sizes; and data collection instruments and procedures had acceptable levels of reliability.

(b) Most of the threats to internal validity—including history, maturation, testing, instrumentation, statistical regression, selection, mortality, and interactions with selection—are controlled or balanced across treatment groups through randomization. Schools, and thus their teachers, were randomly assigned to one of the three QUILT treatments, and the selection of participants for the special sample was based on simple random sample selection procedures.

Some internal validity threats are not controlled by randomization. Diffusion or imitation of treatments, compensatory equalization of treatments, compensatory rivalry, and resentful demoralization are problems when participants in different treatment groups are able to communicate with each other about their treatments. While these cannot be totally controlled in most field situations, the QUILT field test minimized these threats by having treatments assigned on a whole school basis rather than having multiple treatments occurring within a school.

Another rival hypothesis associated with this threat is that teachers staged their behaviors for the camera during the videotaping of the 15-minute questioning episodes; that teachers would not necessarily be using QUILT behaviors "off camera." This is a potential threat any time an observation—"live" or videotaped—intrudes on the usual private teaching-learning transaction. Instructions to teachers in all three treatment groups were the same, and pretest and posttest instructions were identical.

(c) Threats to construct validity involve the possibility that the treatments are not well-defined, not implemented in ways intended (such as Rosenthal effect), or are viewed by participants in different ways than intended (such as the Hawthore effect). Great care was used in the design of treatments and in the delivery of training to QUILT trainers to minimize construct validity threats. In addition, the use of a single treatment (as opposed to multiple treatments) with each given school reduced some of these threats. Effects were observed over a significant period of time (a full year) and consistent effects were observed across a number of different types of schools in 13 districts in four states. Threats to construct validity would tend to lead to mixed results and lack of long-term effects. Such was not the case in QUILT.

(d) External validity threats relate to the generalizability of the results. Had only one school district been involved in the field test or had a limited set of grade levels or content areas, this would be a concern. However, consistent results were observed across several different schools representing different grade levels, content areas, and types of schools and across four different states. The key to establishing external validity is demonstrating the replicability. Results of the QUILT field study clearly indicate effectiveness in several different settings.

In summary, rival hypotheses were controlled, or effects minimized by using powerful statistical methods with planned, directional hypotheses; random assignment of schools to treatment conditions; random selection of subjects for observational data collection; within-school singular rather than multiple treatments; well designed materials and high quality of training for district-based trainers; and replication of treatments in several settings.

F. **Educational Significance of Results**

1. **Relationship of results to needs.** Increased use of effective questioning techniques can make a tremendous impact on the teaching-learning process. Educational researchers consistently report that all teachers dedicate a large portion of their class time (40 percent, on the average) to questioning and that, for the most part, teachers do not use questioning techniques correlated to positive learner outcomes. Prerequisite to the improvement of practice is *knowledge* of what constitutes effective practice. The QUILT program resulted in significant increases in teacher knowledge of effective questioning practices and procedures. Knowledge alone, however, does not result in improvement—a premise confirmed by the 1991-92 QUILT field test in which two alternate treatment groups (Conditions B and C) showed significant increases in knowledge of effective questioning practices, but little positive change in their use of these practices. On the other hand, QUILT (Condition A) teachers significantly improved their performance in seven questioning behaviors. The QUILT program compels teachers to reflect upon their classroom practices—to think about the what, how, and why of their questions and interactions with students; to compare their personal behaviors with "best practice"; and to collaborate with peer partners in pursuit of personal improvement objectives. QUILT also promotes a schoolwide climate and culture that nurture individual change.

While QUILT's primary focus is upon changing teacher questioning behaviors, its ultimate goal is to impact student learning and thinking. Students become more accountable for their own learning in QUILT classrooms where teachers use wait times I and II, pose questions before designating respondents, redirect questions, and do not habitually repeat student answers. Moreover, students learn how to think and question (metacognition) when teachers actively instruct them in these processes and procedures and model their use. QUILT's classroom applications provide direction and structure for student learning in this area. Moving students beyond short answers to lengthier and more complex responses is a goal of most present day reform movements. Four changes in the questioning behaviors of QUILT-trained teachers promote this goal: the reduction in the total number of questions asked; the increase in the number of questions posed at higher cognitive levels; and the use of wait times I and II. In QUILT classrooms, students also significantly increased their responses at higher cognitive levels. Increases in student thinking is a universal goal for education.

2. **Comparison of results to results from other programs.** We could identify no other program (i.e., a process for changing behaviors over the long-term) that (1) focused upon the entirety of the questioning process (i.e., the content was comprehensive), and (2) had been rigorously evaluated and found to change significantly teacher performance in this area.

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The QUILT Model:

Teacher Behaviors for Effective Questioning

Stage 1: Prepare the Question

- Identify instructional purpose
- Determine content focus
- Select cognitive level
- Consider wording and syntax

Stage 2: Present the Question

- Indicate response format
- Ask the question
- Select respondent

Stage 3: Prompt Student Responses

- Pause after asking question
- Assist nonrespondent
- Pause following student response

Stage 4: Process Student Responses

- Provide appropriate feedback
- Expand and use correct responses
- Elicit student reactions and questions

Stage 5: Critique the Questioning Episode

- Analyze the questions
- Map respondent selection
- Evaluate student response patterns
- Examine teacher and student reactions

Annotated Bibliography:
Resources on Effective Questioning for Teachers and Staff Developers

Dantonio, M. (1990). How can we create thinkers? Questioning strategies that work for teachers. Bloomington, IN: National Education Service.

This manual, intended for use by study groups of staff development leaders and teachers, is designed for ongoing, interactive inservice to promote use of more effective questioning strategies and techniques within the classroom. It is not a "program," but rather gives suggestions for breaking the content into manageable pieces (over time), providing for use in the classroom, with a peer-observer for feedback.

Dillon, J. T. (1988). Questioning and teaching: A manual of practice. New York, NY: Teachers College Press.

This easy-to-read text presents Dillon's view of questioning and makes distinct the different purposes of questioning in (a) recitation and (b) discussion.

Hunkins, F. P. (1989). Teaching thinking through effective questioning. Norwood, MA: Christopher-Gordon Publishers, Inc.

This textbook is a comprehensive look at questions in the classroom. Hunkins provides examples as he presents information about levels of questions, types of questions (cognitive vs. affective), focus and syntax of questions, using questioning within the classroom, and student questioning.

North Carolina Department of Public Instruction, Division of LEA Personnel Services. (1989). Extending thinking through effective questioning. Raleigh, NC: Author.

Developed as three (3) three-hour workshops, these materials cover three major topics related to effective questioning: (a) importance of questioning, (b) levels and types of questions, and (c) strategies and techniques for effective questioning. The workshop materials were developed with appropriate activities, overhead transparencies, and scripts for trainers.

Wiederhold, C. (1991). The question matrix: Cooperative learning and critical thinking. San Juan Capistrano, CA: Resources for Teachers, Inc.

A collection of strategies and activities to promote shared inquiry in classroom instruction.

Wilen, W. W. (Ed.) (1992). Questions, questioning techniques, and effective teaching. Washington, DC: National Education Association.

An anthology of articles by noted educational researchers and practitioners in the areas of effective questioning.

Participants in Field Test of QUILT

Districts	Schools
Barren County (KY) Schools	Austin Tracy School Barren County High School Hiseville School
Fort Knox (KY) Community Schools	Fort Knox High School Macdonald Middle School Walker Middle School
Warren County (KY) Schools	Greenwood High School Moss Middle School Warren East Middle School
Giles County (TN) Schools	Elkton School Minor Hill School Southside Elementary School
Lawrence County (TN) Schools	Ethridge Elementary School Leoma Elementary School South Lawrence Elementary School
Tullahoma (TN) City Schools	Bel Aire Elementary School Farrar Elementary School Robert E. Lee Elementary School
Augusta County (VA) Schools	Hugh Cassell Elementary School Farrar Elementary School Verona Elementary School
Campbell County (VA) Schools	Altavista High School Brookville High School William Campbell High School Rustburg High School
Cabell County (WV) Schools	Barboursville High School Barboursville Middle School Geneva Kent Elementary School Hite-Saunders Elementary School
Diocese of Wheeling-Charleston (WV)	Notre Dame High School St. Agnes School St. Joseph Grade School
Kanawha County (WV) Schools	Dupont Junior High School East Bank Junior High School Spring Hill Junior High School
Marshall County (WV) Schools	Glen Dale Elementary School McNinch Elementary School Park View Elementary School
Upshur County (WV) Schools	Buckhannon-Upshur High School Buckhannon-Upshur Inter. School Union Elementary School

Summary of Workshop Evaluation Data

Condition A

PLEASE RESPOND TO ALL OF THE ITEMS ON THIS FORM.

For the following items, please circle the number that best indicates the extent to which this session:

# Responding		Not at all	Mean	Very much
345	1. Had clear objectives	1	4.57	5
344	2. Had objectives that were met	1	4.45	5
347	3. Caused me to reflect on my practices	1	4.65	5
347	4. Caused me to examine some of my attitudes	1	4.47	5
344	5. Facilitated development of new skills	1	4.22	5
345	6. Was relevant to my needs	1	4.12	5
342	7. Was conducted in a positive climate	1	4.75	5
347	8. Had activities that were well sequenced	1	4.53	5
347	9. Had activities that reinforced content	1	4.50	5
346	10. Included appropriate examples	1	4.39	5
346	11. Was conducted by a competent trainer	1	4.72	5
345	12. Was conducted in a professional manner	1	4.77	5
342	13. Had meaningful involvement of participants	1	4.50	5
346	14. Has stimulated me to want to use the materials and skills in my position	1	4.37	5
345	15. Provided materials that will be useful to me in the future	1	4.23	5

Following are content areas of the QUILT training that we would like for you to rate on two dimensions: personal knowledge you gained and understandability of the presentations and materials.

Please use the scale: 1 = None or Not at all to 5 = very much

Content Areas	Knowledge Gain			Understandability		
Purposes of questions	1	4.05	5	1	4.27	5
Content focus of questions	1	4.04	5	1	4.21	5
Cognitive levels	1	3.96	5	1	4.23	5
Wording and syntax	1	3.84	5	1	4.10	5
Varying response formats	1	4.15	5	1	4.29	5
Respondent selection	1	4.10	5	1	4.29	5
Wait time I	1	4.34	5	1	4.60	5
Wait time II	1	4.47	5	1	4.55	5
Assisting nonrespondents	1	4.00	5	1	4.22	5
Providing appropriate feedback	1	4.06	5	1	4.30	5
Eliciting student questions	1	3.98	5	1	4.14	5
Recitation vs. discussion	1	4.22	5	1	4.46	5
Critiquing your questioning	1	4.00	5	1	4.06	5
QUILT Model	1	4.32	5	1	4.30	5

Summary of Workshop Evaluation Data

Condition B

PLEASE RESPOND TO ALL OF THE ITEMS ON THIS FORM.

For the following items, please circle the number that best indicates the extent to which this session:

# Responding		Not at all	Mean	Very much
320	1. Had clear objectives	1	4.54	5
319	2. Had objectives that were met	1	4.42	5
322	3. Caused me to reflect on my practices	1	4.58	5
320	4. Caused me to examine some of my attitudes	1	4.42	5
321	5. Facilitated development of new skills	1	4.17	5
321	6. Was relevant to my needs	1	4.05	5
321	7. Was conducted in a positive climate	1	4.64	5
320	8. Had activities that were well sequenced	1	4.40	5
321	9. Had activities that reinforced content	1	4.39	5
321	10. Included appropriate examples	1	4.29	5
321	11. Was conducted by a competent trainer	1	4.62	5
319	12. Was conducted in a professional manner	1	4.67	5
316	13. Had meaningful involvement of participants	1	4.50	5
320	14. Has stimulated me to want to use the materials and skills in my position	1	4.26	5
321	15. Provided materials that will be useful to me in the future	1	4.16	5

Following are content areas of the QUILT training that we would like for you to rate on two dimensions: personal knowledge you gained and understandability of the presentations and materials.

Please use the scale: 1 = None or Not at all to 5 = very much

Content Areas	Knowledge Gain			Understandability		
Purposes of questions	1	4.05	5	1	4.25	5
Content focus of questions	1	4.00	5	1	4.15	5
Cognitive levels	1	3.98	5	1	4.20	5
Wording and syntax	1	3.95	5	1	4.12	5
Varying response formats	1	4.13	5	1	4.26	5
Respondent selection	1	4.05	5	1	4.28	5
Wait time I	1	4.44	5	1	4.66	5
Wait time II	1	4.53	5	1	4.59	5
Assisting nonrespondents	1	3.96	5	1	4.24	5
Providing appropriate feedback	1	4.01	5	1	4.31	5
Eliciting student questions	1	4.01	5	1	4.19	5
Recitation vs. discussion	1	4.28	5	1	4.48	5
Critiquing your questioning	1	3.99	5	1	4.04	5
QUILT Model	1	4.31	5	1	4.29	5

Summary of Workshop Evaluation Data

Condition C

PLEASE RESPOND TO ALL OF THE ITEMS ON THIS FORM.

For the following items, please circle the number that best indicates the extent to which this session:

# Responding		Not at all	Mean	Very much
372	1. Had clear objectives	1	4.54	5
370	2. Had objectives that were met	1	4.36	5
372	3. Caused me to reflect on my practices	1	4.44	5
371	4. Caused me to examine some of my attitudes	1	4.28	5
370	5. Facilitated development of new skills	1	3.99	5
370	6. Was relevant to my needs	1	4.01	5
370	7. Was conducted in a positive climate	1	4.52	5
367	8. Had activities that were well sequenced	1	4.39	5
368	9. Had activities that reinforced content	1	4.22	5
371	10. Included appropriate examples	1	4.17	5
372	11. Was conducted by a competent trainer	1	4.65	5
370	12. Was conducted in a professional manner	1	4.73	5
359	13. Had meaningful involvement of participants	1	4.26	5
371	14. Has stimulated me to want to use the materials and skills in my position	1	4.20	5
371	15. Provided materials that will be useful to me in the future	1	4.03	5

Pre- and Posttest Comparisons on Questionnaire About Effective Classroom Questioning, Percent Correct by Subscale and Total

		Treatment Condition A, n= 297 Pre	A, n= 297 Post	B, n= 200 Pre	B, n= 200 Post	C, n= 292 Pre	C, n= 292 Post	Group Differences in Means* Post	Change
Effective Questioning	M	40.5	52.9	42.3	46.2	40.8	41.1	A>B	A>B
	s	20.4	22.1	20.2	21.6	19.9	19.9	A>C	A>C
s_{pre}= 20.2	ES	0.61		0.19		0.01			
Post-Pre M Diff.	p	<0.001		<0.05		nsd			
Teacher Feedback and Reaction	M	49.3	54.5	49.1	52.5	49.5	48.4	A>C	A>C
	s	13.6	15.0	12.7	14.8	13.0	13.9		
s_{pre}= 13.1	ES	0.39		0.25		-0.08			
Post-Pre M Diff.	p	<0.001		<0.01		nsd			
Discussion vs. Recitation	M	37.1	46.1	37.6	42.6	35.8	39.1	A>C	A>C
	s	20.9	20.8	22.1	21.2	20.7	20.5		
s_{pre}= 21.2	ES	0.43		0.24		0.16			
Post-Pre M Diff.	p	<0.001		<0.01		<0.05			
Respondent Selection Response Format	M	44.7	50.9	45.1	47.9	40.7	43.1	A>C	A>C
	s	17.2	17.0	18.1	18.7	16.7	17.2		
s_{pre}= 17.3	ES	0.36		0.16		0.14			
Post-Pre M Diff.	p	<0.001		<0.05		<0.05			
Cognitive Levels	M	50.7	64.1	52.3	57.8	48.5	51.1	A>B	A>B
	s	18.6	20.1	18.2	19.5	17.7	19.3	A>C	A>C
s_{pre}= 18.2	ES	0.73		0.30		0.15			
Post-Pre M Diff.	p	<0.001		<0.001		<0.05			
Wait Time	M	50.5	78.8	49.4	68.9	46.3	56.2	A>B	A>B
	s	22.7	21.5	22.1	24.0	20.5	23.4	A>C	A>C
s_{pre}= 21.8	ES	1.30		0.89		0.46			
Post-Pre M Diff.	p	<0.001		<0.001		<0.001			
Total QECQ	M	46.8	58.2	47.2	53.4	45.1	47.4	A>B	A>B
	s	10.3	12.3	9.7	12.7	9.1	10.5	A>C	A>C
s_{pre}= 9.72	ES	1.17		0.64		0.24			
Post-Pre M Diff.	p	<0.001		<0.001		<0.001			

*$p < 0.05$

Information About the Videotaped Lesson For the QUILT Research Program

You have been selected as part of a special sample of teachers involved in the QUILT Research Program. As a consequence, you will be videotaped for a 15-minute segment of instruction.

Background Information

QUILT stands for Questioning and Understanding to Improve Learning and Thinking. QUILT is a professional development program for classroom teachers, designed to enhance classroom questioning techniques and thus to increase student learning and thinking.

Your school is involved in implementing QUILT—or at least one portion of QUILT—and has agreed to collect data with which we can evaluate the effectiveness of the QUILT program. The videotape will be used as one measure of program effectiveness. It is important for you to understand that this videotape will help us evaluate the effectiveness of the QUILT program; it will not be used to evaluate or assess your effectiveness as a teacher or classroom questioner.

All of the QUILT videotapes will be sent to the Appalachia Educational Laboratory, where they will be coded by one of four teachers specially trained in the QUILT observational system called Classroom Questioning Observation Instrument. The data will always be reported as group means; your individual score will never be reported.

What We Want on the Videotape

We would like a 15-minute segment of your teaching or reviewing a lesson of your choice in which classroom questioning is your primary instructional technique. Please try to use your natural style of question-asking as much as possible. As you know, there are no absolute right and wrong ways of teaching; we simply want a sample of how you typically might use questioning in your current classroom.

Arrange with your QUILT coordinator your choice of when to be videotaped. Please complete the Teacher Information Sheet attached and return it to your QUILT coordinator, to be returned to AEL with the 15-minute videotape of your class.

We think that this research is important and will make a substantial contribution to the literature about teacher change through staff development. We anticipate that the results will be useful to people in school districts all across the country. Thanks for your help in making it possible.

QUILT Observation data results - Year 1
For teachers with data at both times.

Wait-time I (Percentage of time)

At zero seconds

		Pre		Post		
	n	M	SD	M	SD	Change
A	37	57.07	18.81	41.73	32.76	-15.33
B	28	61.50	14.46	44.93	28.73	-16.56
C	30	65.20	17.56	64.88	33.68	- 0.32
T	95	60.94	17.39	49.98	33.22	-10.96

At 0.5 seconds

		Pre		Post		
	n	M	SD	M	SD	Change
A	37	8.10	11.01	3.73	5.38	- 4.37
B	28	6.27	6.92	7.62	10.13	1.35
C	30	7.31	6.54	3.56	5.91	- 3.75
T	95	7.31	8.60	4.82	7.39	- 2.49

At 1 seconds

		Pre		Post		
	n	M	SD	M	SD	Change
A	37	10.31	6.56	13.01	11.74	2.70
B	28	10.57	7.96	9.51	8.08	- 1.06
C	30	8.11	6.80	9.71	11.89	1.60
T	95	9.69	7.08	10.94	10.86	1.25

At 2 seconds

		Pre		Post		
	n	M	SD	M	SD	Change
A	37	10.28	8.67	15.37	12.29	5.09
B	28	9.86	9.05	16.58	12.61	6.72
C	30	7.65	6.58	10.00	15.25	2.35
T	95	9.33	8.19	14.03	13.53	4.70

At 3 or more seconds

		Pre		Post		
	n	M	SD	M	SD	Change
A	37	12.82	11.90	24.99	24.87	12.17
B	28	11.11	10.05	20.70	19.49	9.58
C	30	10.11	14.81	11.50	16.54	1.39
T	95	11.46	12.34	19.47	21.52	8.01

QUILT Observation data results - Year 1
For teachers with data at both times.

Wait-time II (Percentage of time)

At zero seconds

		Pre		Post		
	n	M	SD	M	SD	Change
A	37	90.88	10.11	64.61	34.05	-26.27
B	28	96.16	3.93	80.10	24.63	-16.05
C	30	92.04	8.40	84.67	23.85	- 7.37
T	95	92.80	8.39	75.51	29.56	-17.29

At 0.5 seconds

		Pre		Post		
	n	M	SD	M	SD	Change
A	37	1.24	2.77	5.61	8.83	4.37
B	28	0.95	2.13	2.32	6.16	1.36
C	30	2.68	4.21	2.61	4.46	- 0.07
T	95	1.61	3.20	3.69	7.02	2.08

At 1 seconds

		Pre		Post		
	n	M	SD	M	SD	Change
A	37	2.38	4.78	17.53	25.67	15.15
B	28	1.13	1.89	9.39	21.43	8.25
C	30	0.56	1.32	7.33	18.09	6.77
T	95	1.44	3.31	11.91	22.50	10.47

At 2 seconds

		Pre		Post		
	n	M	SD	M	SD	Change
A	37	1.19	3.10	4.60	8.17	3.41
B	28	0.33	1.24	2.29	5.73	1.96
C	30	0.82	3.15	1.48	3.23	0.66
T	95	0.82	2.70	2.93	6.33	2.11

At 3 or more seconds

		Pre		Post		
	n	M	SD	M	SD	Change
A	37	0.52	1.28	2.98	6.73	2.46
B	28	0.10	0.51	0.59	1.61	0.49
C	30	0.59	2.06	0.97	4.57	0.38
T	95	0.42	1.43	1.64	5.07	1.22